THE PROCEEDINGS
of
THE INSTITUTION OF PRODUCTION ENGINEERS

The Official Journal of the Institution of Production Engineers

Members are requested to correspond with the Editor upon matters of general interest. Letters may take the form of descriptions of unusual plant or tools, workshop methods, production problems or organisation systems. Only in exceptional circumstances will proprietary articles be dealt with editorially. Manufacturers wishing to draw the attention of the Institution to the merits of their products are invited to use the advertisement columns of this Journal. All correspondence should be addressed to the General Secretary, Institution of Production Engineers, 40, Great James Street, Bedford Row, London, W.C.1.

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INAUGURAL MEETING OF THE GLASGOW SECTION OF THE INSTITUTION.

THE Inaugural Meeting of the newly-formed Glasgow Section of the Institution was held at the Royal Technical College, Glasgow, on Tuesday, 21st October, 1930, at 7-30 p.m. Mr. William Pate, B.Sc., first President of the new Section, occupied the chair, and the attendance numbered about two hundred.

Messages of congratulation on the formation of the Glasgow Section and of good wishes for its success were received from Mr. Tom Thornycroft (President of the Institution), Mr. R. H. Hutchinson (Past President), Mr. H. E. Weatherley (President of the London Section), and others.

MR. WILLIAM PATE, Chairman, in opening the meeting said: It is my privilege to welcome you to this Inaugural Meeting of the Glasgow Section of the Institution of Production Engineers. How it has come about that another encroachment on your so-called leisure hours is suggested is a matter that will reveal itself later in the proceedings. At the moment, permit me to thank you who are here, and many others who have not been able to attend, for the interest already taken in the activities of the Institution which

has justified the calling of this meeting. I am going to repeat a query which has been put several times since the project to form a Section in Glasgow was first mooted. The question is this: What purpose is to be served by another Institution in our midst, surely there are quite sufficient already, all well qualified to look after the various forms of engineering represented in the district? The answer turns upon the fact that while the technicalities of design and materials have been well looked after by various bodies of specialists, the manner in which the theories and plans have to be translated into the finished product at a sufficiently low cost has in practice been relegated to a position which is not adequate to its importance. Instead of competition with established bodies I would ask you to visualise a common interest running through the majority of manufacturing processes. Whether it is in the making of bolts and nuts, or ships or locomotives or motor cars, or of the machines employed in the fabrication of the thousand and one necessities of modern life, there is the science or art of manufacture in all of them to a greater or lesser degree. The Institution of Production Engineers makes a study of the comparatively new science which is involved, and in so doing ensures that the work of the technicians is the more effectively realised. For that reason I submit that a very real purpose is to be served by the Institution of Production Engineers, and its importance will grow as industry becomes still further specialised. Of course, it is quite obvious that practices which suit the manufacture of typewriters cannot be applied to the construction of an ocean-going vessel, but nevertheless the common interest is there—let us call it the engineering of production—something which is not to be confined merely to formulæ and the use of squared paper, to costing systems and methods of payment. Much use has been made of the phrase "scientific management" since it was introduced a few years ago, and I offer that also as giving some indication of the direction in which production engineers can work harmoniously alongside existing societies. For the rest, the answer has this evening been entrusted to the very capable hands of Mr. Groocock and Mr. Hannay, so it is quite superfluous for me to say more on that subject. But there is another aspect of the matter to which I would direct your special attention for a few minutes, and that is the relation of the production engineer to the problems and difficulties which confront our industrial life to-day. Fortunately, it is no part of my duty to-night to suggest explanations for these difficulties, and however much we seek to understand them, inevitably there comes the question, "What are we going to *do*—*what* and *how* and *when*?"

The future of our industries still depends upon the application of the doctrine of self-help just as it has always done, and while efficient production is not by any means the beginning and the end of the business, there is no time to lose in the systematic search for

what has been called the " one best way " to do each and every job that falls to be done in the day's work. It is the function of the production engineer to find that elusive " best way " and to organise for its success, always in the knowledge that what served yesterday may be lacking in some respect to-morrow. This Institution has grown out of the realisation that there is a technique in modern manufacture which was quite uncalled for in the days of development from small beginnings. That technique is adaptable and adjustable; it balances values with a precision necessary to withstand the acid test of " will it pay " and I need scarcely remind you that business without profit just gradually ceases to exist. In the stress of modern competition with its facilities for price comparisons, it is necessary to examine closely every aspect of the problem of getting our goods sold both at home and abroad, and while salesmanship has figured prominently in the diatribes directed at British industry as a whole, it is well to remember that ultimately even the best salesmanship will not avail if the requirements of economical production are ignored. There is no absolute measurement of these requirements, and they are therefore the more difficult to translate into action, but it is just here that the art of the production engineer must be developed. A higher standard of efficiency is imperatively called for in our engineering industries generally, requiring an effort steadily directed towards elimination of waste—waste of time, waste of effort, waste of material—quite as much as towards development of new processes and methods. There is need for engineers specialising in work of this nature, and the circumstances in which we find ourselves to-day make it a matter not of local but of national importance, that manufacturing efficiency is considered a subject deserving of intensive study. For these reaons it is my belief that the Institution of Production Engineers has quite an important rôle to fill and should make strong appeal to a wide range of industries in and around Glasgow. I will now ask Mr. Groocock to give his address on " The Work and Scope of the Institution " and am sure that he will have much to say of interest to us all.

THE WORK AND SCOPE OF THE INSTITUTION.

MR. W. G. GROOCOCK, President, Birmingham Section, said: On this, the opening night of the Glasgow Section of the Institution of Production Engineers, I feel specially honoured at having the opportunity of addressing you. My first duty, and it is also a pleasure, is to convey to you all a message of goodwill from our Council. We were all delighted to hear of Glasgow's decision to form a Section of the Institution, and I am instructed to inform you that the Council will do everything in their power to assist you in making the Glasgow Section a success.

Our Institution.

In my address to you to-night I feel that there is no possible subject that will interest you more than to tell you something of our Institution. Firstly, I want to show you that the productive methods of industry during the latter part of the nineteenth century so sub-divided engineering that the formation of an Institution of Production Engineers was inevitable. Secondly I will, as far as time permits, briefly review what the Institution has done and is doing, and in connection with this, give you a resumé of our organisation. Finally, I will try and visualise the future, indicating the need for a scientific development of production engineering, and conclude by letting you know something of our hopes for the future.

The Foundations of Engineering.

Those men who built the foundations for the huge structure which we now call engineering, built on solid rock, and the more we examine the work they did, the more amazed we are at the soundness of the foundation they prepared for us. We have been told that "Mankind would make very little progress in any science or art if they made no use of the experience of their predecessors." Our early engineers soon realised this truth and formed amongst themselves associations which should act in the way of bringing them together, thus forming a clearing house for their ideas. The basic idea then as now, was that their Institutions should arrange meetings, etc., so that searchers after truth could gather together and collect grains of knowledge, thus building up experience which would be useful to their generation and posterity.

Retrospect shows us that the rapid increase in the standard of comfort which we are enjoying to-day is largely the result of the work of these pioneers. By the introduction of machinery they not only replaced the drudgery of labour by mechanical means, but these machines did more than remove drudgery—they increased production enormously.

Evolution of Production Engineers.

During the nineteenth century, not only did the work done by the engineer grow very rapidly, but it became extremely complicated, with the result that some measure of specialisation was forced on the engineering industry. It soon became apparent, for instance, that the only way to make articles in quantity, and cheaply enough to extend our markets, was to make them accurately within certain limits, and this was the birth of interchangeability. This change in the basis of manufacture eventually made a wonderful difference, both in quantity, quality and price. Incidentally, too, it was the real beginning of the production engineer, although it was many years later before the name came into current use. Interchangeability is impossible without standardised tools and gauges, and this development eventually brought along the tool room. At this stage the tool designer materialised, first as a junior who could put on to paper the ideas of the tool room foreman and others, later as a specialist with his own ideas.

Now, no one can design efficient jigs and tools or gauges without a full knowledge of the operations and processes involved, and the necessity for having the operations in a logical sequence is recognised as one of the first considerations to successful manufacture. Here then was the beginning of the planning department.

The next step that we were forced to take was to have someone to see that the work, instead of stopping on the floor after the first operation, was carried forward and progressed at the desired rate from one operation to the next until finished. This brought along the progress man, and at this stage, or hereabouts, inspection was found to be necessary. A proper co-relation between these various sections was found to be essential if we were to get work through in the desired time, and this led us by uneasy (I almost said easy) stages to the production department. Here, experience soon demonstrated that to be successful, the man in charge of production must not only control the manufacturing processes from the very beginning, but he must also control the supply of raw material, and this brought forth the production engineer, and incidentally, an Institution to serve his needs.

From this brief summary of the past it will be seen that as engineering developed it became more complicated, and very naturally, first one section and then others, were forced to the conclusion that they must have some means of keeping in touch with the latest developments of their particular sphere of activity. This led ultimately to the founding of the Institution of Production Engineers. You will see, therefore, that the formation of our Institution was a natural sequel to the evolution of production engineering and the production engineer.

Practical Workshop Science.

The advisability or otherwise of this division of the activities of engineers into groups, has often been questioned by the ill-informed. It has been suggested that division is not necessary, but engineering is too complicated to-day for any one Institution to cater fully for all the various sections. They are all necessary. One might just as well question the development of machine tools we use. Starting with the primary machine tool, the lathe, we progressed step by step to the planer, the shaper, and the miller to the grinding machine, and from each of these there are many sub-divisions of type, some standard, many special. No one questions this development as we know that all are useful in their own particular sphere. So it is with the many sub-divisions from the parent engineering institution. There are no clear lines of demarcation between some of them, and quite often their interests overlap, but in general, each section feels that it must have a technique of its own.

Professor Huxley once said, "As industry becomes more complicated and competition more keen, the sciences are dragged in one by one to take part in the fray, and he who can best avail himself of this help is the man who will come out uppermost in the struggle for existence." Production engineers realising this truth know that they must have a technique of their own, and to establish this the Institution was founded so that the knowledge of many could be used to form the basis of a new and more scientific conception of what is meant by a production engineer. You will realise from what I have said that it was found that there was a real need for an Institution dealing with practical workshop science. The older Institutions catered mainly for the academic and technical side of engineering as represented by the designer. Our Institution caters mainly for the practical side as represented by the works manager and production chiefs.

Do We Overlap ?

Our General Secretary informs me that there is no real evidence of over-lapping with other Institutions. Of the last two hundred members admitted, not ten per cent. belong to any other national engineering institution. While Glasgow is the headquarters of two most valuable and thriving organisations in the Institution of Engineers and Ship Builders in Scotland and the Glasgow and West Scotland Association of Foremen Engineers and Draughtsmen we, the Institution of Production Engineers, do not overlap, or compete with either of these other Institutions.

The question of overlap with the two organisations mentioned was, I understand, very carefully considered, and it was found that their scope and ours were very different. This same issue of overlap also arose in the case of Coventry, Birmingham and Manchester, all of which towns have very strong local associations. Our Council

have worked out an affiliation scheme to bring about mutual co-operation with the smaller engineering associations, and no doubt that scheme may, in the future, be extended to include co-operation also with the larger local associations.

Scope of the Institution : What are we Doing ?

Enough has been said, I think, to show that our Institution was necessary, and a question we can rightly ask ourselves now is : What have we done to justify our position as a separate Institution ? Starting with one Section, the Society has broadened its basis until to-day we have Sections in London, Coventry, Birmingham, Manchester, Luton, and now Glasgow. Each new step as it has been taken, has added to our confidence that we are working along the right lines. With regard to this, the Glasgow Section, our youngest baby, anyone who is here to-night will agree with me that everything promises well for a huge success.

It is opportune now, I think, to ask the question, What is the scope of our Institution ? Broadly, the Institution concerns itself with all the main problems the production engineer has to face. My definition of a production engineer is that he is a trained engineer who is engaged in producing by mechanical means, and otherwise, any commodity that will maintain or improve the standard of comfort of the community. These commodities he must make from any and all the materials that nature and the scientists have placed at his disposal. His chief problem is that of devising ways and means to increase the productivity of the particular plant to which he is attached.

There is no need for me to apologise to production men for emphasising the need for increased production. The subject is one which most of us regard as not only vital to the industry we serve, but vital also to a national ideal of an improved standard of living. What then are the principle problems which the production engineer has to face ? In my opinion these can be roughly divided as concerning themselves with men, machines, and methods.

Men, Machines, Methods.

It is quite clear that these three major problems of men, machines and methods may, as subjects, be sub-divided into further groups, many of which would, however, be closely related to others. In general, however, and for the purpose of my discussion I propose to look upon these three as containing the major problems of the production engineer.

Now, what are we as an Institution doing to promote discussions on subjects that affect these major problems ? Looking back on the work of the past, you will find from an examination of our syllabuses that we had touched every single phase and with an infinite number of varieties from each of these phases. I do not propose to-night to deal at any length with this, but I would like

to indicate just how we are dealing with this during our present session, and for the purpose of illustration, I am selecting only twelve of the lectures that are being given.

Men.

The most important problems that production engineers have to face are obviously those problems which touch on the study of human beings. There is no study more interesting, neither will any of our studies yield a greater return than those where our thoughts are on human beings and their welfare. As production engineers we know that if we have the best steel that the scientists can give us, it may fail to function properly unless it is also treated properly. This is also true of the human material we have to handle to achieve our ends. From the point of view of humanity alone this human material should be treated well, but from the point of view of production, proper treatment will yield ample returns for any efforts we may spend in this direction.

In the papers arranged for this session there are several which deal specifically with human aims. One of the most common sources of difficulty when handling men is the question of payment for the work they do. Your Council last year, with a view to finding out what kind of lecture was desired by its members, took a postal ballot, and the result of this ballot was that the subject of "Payment by Results" came out at the head of the poll. It is a subject well worthy of all the study we can give it, and yet there are many people who do not appreciate just all the complications that it involves. I have heard it said that there is nothing to discuss in " Payment by Results " yet I know of no subject in engineering production that is so full of possibilities for either failure or success. It is an intricate subject with huge possibilities, and at the moment I do not think that we have even touched the fringe of these possibilities. Every Section of our Institution has undertaken to have a paper, or discussion on the subject of " Payment by Results " or some kindred subject, and our Institution should by this means collect a wealth of very valuable material from this series of papers and discussions.

Another human problem is the safety of our people while at work. The Birmingham Section have already discussed this subject following a lecture given on " Safety Devices on Production " and a point which was brought out both by the Chairman and the lecturer is well worth our fullest and deepest consideration. That was, that there is always a drop in efficiency of any department if there is an accident or a series of accidents. It was also emphasised that cheap production need not of necessity lead to accidents, as a matter of fact, production is not cheap when accidents occur, as such accidents invariably disorganise production and lead indirectly to increased costs.

Another lecture that is on our syllabus for the session, which

really touches the human side is "The Method of Measuring Productive Efficiency." Most of us have been looking for such a method for many years. We have put in an organisation to take care of our production. We have watched it at work and have not been satisfied, we make changes and still we are not satisfied, then ultimately we perhaps get to the point where we cannot see any further changes that would help us. It is at this stage that we would like to know how efficient our organisation is, and a lecture dealing with a "Method for Measuring Productive Efficiency" ought to be helpful to all of us. The finest scheme in the world may fail through the inefficiency of our human material, and it will be helpful if someone can tell us how to gauge our productive efficiency.

Another lecture which has been given at our London Section was on the subject of "Up-to-date Management." This is a very human problem, in fact, management very largely concerns itself with human problems. All the lectures that we have during the session are on subjects that are vital to the works manager, whether he controls a large or small works. Our papers and the ensuing discussions raise matters that are invaluable to the works manager. I believe, however, that this specific paper on "Up-to-date Management" given to the London Section by an expert on the subject, did deal very largely of necessity with the human side of our industry.

Machines.

It is sometimes difficult to separate subjects as coming under one or other of the three main problems, but I am placing the "Development of Efficient Methods in the Foundry" as being a machine subject, simply because it isn't conceivable to-day that any efficient foundry could exist on production work without efficient machinery. We are to have a lecture on the subject of the "Development of Efficient Methods in the Foundry," and I am quite sure that there will be few more interesting lectures than this particular one. Production men generally are a little sore at the foundries and foundry methods. For many years the foundry has stood still whilst other sections of the industry were progressing, and it is only recently that in one or two cases the foundries in this country have been brought relatively up-to-date, that is, properly mechanised. There is still much to be accomplished in foundry production, and a lecture such as we are to have on "Efficient Methods in the Foundry" should be of extreme importance to all of us. In my opinion, the inefficiency of the foundry in the past has not always been due to the foundry men themselves. It has often been due to the inefficient line of thought of those in control of the money. Foundries without money to buy efficient machinery cannot hope to be efficient foundries.

A parallel subject to the foundry work is "Die Casting." Defi-

ciencies of the foundry in the past, combined with new designs, have led to a great extension of die casting of various kinds, and the lecture on "Die Casting and its Future" to be given before our Luton Section should bring out many new points which will assist us generally in our productive conceptions. As years go on there will be a great increase in this class of work.

Another re-action from foundry inefficiency, is the amount of work that is being done on presses which formerly used to be done in the foundry. Much foundry work has of late years been supplanted in many cases by press steel components, and the Institution is to have the advantage of three lectures dealing with "Press Production." Birmingham are to have a lecture on "The Cold Working of Metals"; Coventry has a lecture on "Press Production," and the Luton contribution is to concern itself with "Press Tool Design and Manufacture." The fact that three of our sections are dealing with this subject of press work, indicates what an important subject it is becoming in production work.

Machine Tools.

Several sections are discussing various phases connected with machine tools, such as "Hydraulic Transmission and Machine Tools," to be given at the Manchester Section, "Hydraulics in Design" before the London Section, and "Modern Tendencies in Machine Tools" before the Manchester Section. All these lectures I am quite confident, will bring forward innumerable points for discussion, and the lectures and discussions which follow will help, quite frequently, to clarify our ideas of good standard design, or fruitful design for special circumstances. Ever since the introduction of high speed steel there has been constant competition between the cutting tools and the machine. First the tool would dominate, then the machine, until to-day we have efficient tools driven by extremely powerful machines. Every time I watch one of these super machines at work, taking huge cuts at high speeds, I am filled with admiration and regret. Admiration at what the machine tool designer and the steel maker have accomplished; regret for the waste of good material that is taking place. Our line of action in the future must be towards designs that are not so wasteful of material. Fabrication instead of heavy forging and castings is doing much in this direction. Another factor that will help is the new cutting alloys, Widia, Carboloy, etc. These definitely call for a different design of machine tool which will give high speed without gearing. To meet the conditions imposed, the machine tool designers will call to their aid electricity, hydraulics, and most likely also we shall before long see both steam and air turbines attached directly to machine tools with a view to getting the high speeds that these new cutting alloys demand. The papers and discussions on machine tools will undoubtedly clarify our ideas on many such

points and must be of value to our members.

Methods.

Under methods, there are four papers in our syllabus for this year that I would particularly draw to your attention. The first of these is " Drawings for Production." This subject is one that is worthy of the closest study. Many failures in the past, if properly analysed could be distinctly attributable to a defective system in the drawing office. There are, of course, some kinds of engineering work that is of such a repetition character that drawings lose some of their importance because everyone concerned in the manufacture is well aware of what is wanted. Furthermore, under such a condition gauges are so complete that the question of size is dealt with automatically but, and this is the point I wish to make, unless the drawings are suitable for production, then even in such an establishment where repetition is the order, there will be a tremendous waste of effort at the beginning, and periodically this same trouble will arise in different forms. This is an extremely important question both to production and managerial staffs.

Ford Production Methods.

This year four of our sections will have the opportunity of listening to a lecture on " Ford Production Methods " given by one of our members, Mr. T. Gorst, who is Works Manager of the Ford Motor Company Ltd., Manchester. I have already had the opportunity of listening to Mr. Gorst, and his lecture confirmed an opinion that I have held for many, many years, namely that the world of production does not realise to the full what a tremendous influence in engineering production Henry Ford has been. He blazed a trail along an entirely different territory from that ever taken before. It is perfectly true that many of his methods were not exactly new, but their conception as applied to engineering was distinctly novel and epoch making. We owe a debt of gratitude to Henry Ford for the ideas he has planted in our minds, and I am quite sure that our members will benefit largely from further consideration of " Ford Production Methods."

Organisation and Control of Factory Production.

This is a subject of extreme importance, no less important because it can never be definitely settled. As the world progresses, as our work goes forward and we change methods, so we must constantly bring up-to-date our Organisation and Control of Factory Production. Our members are to have the advantage of a lecture on this subject, and there is no doubt that from this lecture and the discussion which follows, many points will emerge which will be helpful. As I have just mentioned, there is no finality on a subject of this kind, and the only way we can keep relatively up-to-date is to read and hear what others are doing. This is the main function

of our Institution, and it is particularly on this and kindred subjects that we shall receive the greatest assistance from lectures.

Costing in Relation to Production.

The last lecture I propose to mention is that on "Costing in Relation to Production." Several of our Sections are dealing with this subject from slightly different angles. It is a very vital subject to us, because production men who are not sure of their costs are not sure of anything. One often hears the statement made that one system of machining is better than another, or this method of doing the work is better than that. Such statements are to me of no value at all unless they are backed up by proof in the form of costs; even then one has to know something of the establishment in which the work was done, and most vital of all before passing an opinion, one would have to know of the *force* that did the work.

I think you will agree with me that the two criteria of success for the production man are first, the quality of his work, and secondly that it is turned out at a competitive price. He may maintain his quality, but fail on the competitive price side, and in such a case, although his production is super-excellent, if it cannot be sold it might just as well be poor quality from the point of view of making money. It is for this reason, therefore, that knowledge of costing in relation to production is so extremely important for the production man.

I venture to think that in the arrangement of a series of lectures such as is given in our syllabus, a brief outline of which I have given you, the Institution is justifying its existence as a separate Institution. A study of our syllabus will show that all our lectures are vital to a proper appreciation of the problems of production. It will also show that no other Institution covers the same line of activities, or even approaches the subjects that we, as production engineers, wish to have discussed. This being so there is, therefore, no question of overlapping.

Organisation of Our Institution.

I would like now to say a few words about the organisation of our Institution. First I will tell you that one of the finest moves that your Council ever made, and a move which will compel success for our Institution, was the appointment of a General Secretary. In Mr. Hazleton we have a man designed by nature to make a success of such a job. The more you know about him the better you will like him. The more you see of him the more he will get you to work for the good of our Institution.

I have previously mentioned that we have now six Sections. These are very largely self-governed. All are of equal status, and absolutely democratic both in principle and practice. Each Section

decide their own syllabus and manage their own affairs through a President, Committee, and Honorary Secretary.

To my mind, one great advantage that our Institution has over some of the older ones is that we are not a London controlled body, and this decentralisation undoubtedly tends towards efficiency.

Each Section has its own particularly problems in governing difficulties, and this is sure, if properly managed, to work to the common good.

There has been—and I hope there always will be—two factors operating that make for success. Each Section is fired with a desire to make their Section the best, but at the same time, all are keenly conscious that the well-being of the Institution is best served by perfect co-operation. This co-operation is secured by and through the General Council, and on this Council all Sections are represented, and as a consequence it is the perfect media through which to obtain the very closest co-operation. Meetings of the Council will in future be held in various centres, so that there will be a closer link still between Headquarters and Sections.

Our organisation keeps in touch with an ever growing membership by means of various publications. Our monthly Journal gives reports of lectures and discussions, and this monthly journal will soon be right up-to-date. Apart from the journal we have a bi-monthly Bulletin which contains much useful information, and members should keep closely in touch with our General Secretary on matters which they would like distributed and which they feel would be of general use to our Institution.

Another feature recently organised by our General Secretary at headquarters is an Appointments Bureau. This is being well supported by firms, and over fifty vacancies were notified last year. You will see, therefore, that the Institution has fulfilled the obligation it had in mind at the beginning, namely, to provide opportunities for its members to meet and discuss various subjects, to report and circulate the results of such.

Now I want to deal very briefly with the future, and what we hope to do.

The Production Engineer of the Future.

In thinking of the possibilities of the future I have often wondered if we, as an Institution, are not taking too narrow a view of production engineering. We are now in the " Power " age, and many commodities that are at present made by hand will in the future be wholly machine made. Many industries which to-day scarcely use any machines will, in the near future, be dominated by the machine. If this does come to pass, then the management of such concerns will definitely get into the hands of men who, if not production engineers, will have the mentality of the production engineer. I believe that in the future we shall find that many

trained production engineers will leave what we now regard as engineering, and will go over to those other industries where the trained production engineer is needed to ensure success.

Looking back on the achievements of the immediate past we get a wonderful—if dazzling—vision of the possibilities of the future. We have seen that the productive capacity of this island of ours was increased enormously during the nineteenth century. We may be sure that its rate of increase in productive capacity during the remainder of the twentieth century will be such as to make the output of the nineteenth century look microscopic. What does this mean from the point of view of the production engineer? It means, as I see it, that while the problems of to-day are many, they will in the future be multiplied—and become more complicated. To tackle these problems with success will need intelligence of the highest order, coupled with a training in all that science can give us.

The Science of Production.

I believe the production engineer of the future will be more scientific. You and I, Gentlemen, when given a problem in production, consider all the variables—that we can isolate—attach values to each according to our experience, then come to a decision as to the best way to proceed.

Frequently I have thought that there should be better methods for solving such problems, methods that do not rely entirely on personal experience and judgment. I have often wondered whether many of our problems could not be reduced to a formula capable of mathematical application. Some day I believe such a science will be evolved. In this connection I would like to quote from a book—"The Riddle of the Universe," written in 1899, in which the author, Ernst Haeckel, said, "In proportion as the various branches of the human tree of knowledge have developed during the century, and the methods of the different sciences have been perfected, the desire has grown to make them exact, that is, to make the study of phenomena as purely empirical as possible, and to formulate the resultant laws as clearly as the circumstances permit—if possible, mathematically." Gentlemen, I believe this quotation that I have just read to you states our case fully. How are we to develop? Obviously through our younger members who will deal with the future.

Education.

Quite clearly we as an Institution, must take some hand in this question of scientific training. Educational authorities have on many occasions stated that while business men were prepared to criticise the training that is being given, they are not prepared with alternative proposals. Well, we are prepared with alternative proposals, and after a good deal of hard work between members of our Institution and certain educational authorities, courses have

now been laid down for the training of Graduates of our Institution. But what is this technical training? Is it something that we get by the aid of a teacher and which finishes as soon as we leave school or college? Or is it something that is going on the whole of our life and which is to-day known as experience? Obviously the technical training that a young man gets at school or college is merely the background. It is a tool for his use, and until he has learned to use it it is not much value to the community.

Education to the young engineer is like the micrometer to the tool maker, the sextant to the sea captain, or the telescope to the astronomer: until each of these can use the tools of their trade they are not of much value to the community. In my opinion the best way for a young, technically trained engineer to derive the full benefit from his training, is to join an institution that deals with his particular work, to listen to the lectures and to take part in their discussions. If he is receiving training that will fit him for production engineering, then he cannot do better than join the Glasgow Section of our Institution, for by so doing he will always be in mental contact with the men who are doing things. This mental contact is highly desirable at all times.

Our Hopes for the Future.

Needless to say, our immediate hope for the future is that this Glasgow Section will be the success which its opening night suggests. In the knowledge and practice of engineering, Glasgow need yield place to none, and your Council may, I am sure, look forward with confidence to the work that you will do. We are particularly desirous that Glasgow should be a success. Material for a large membership is here; some of the best engineering experience of the world is concentrated in this district, and that being so, all that is needed is to bring this experience to your meetings—either to read papers or to discuss them. When that is done your Council will look forward to the time—a time not far distant—when Glasgow will have grown so large that other centres for our activities in the North will seem desirable.

Future Developments.

As our Institution grows in numbers and strength we must have an increase in the number of sections, until we are represented in every industrial centre of the British Isles. This will assist us towards an increase in membership. But while membership is important, the most important advantage that we get from belonging to this Institution is by attendance at lectures and by taking part in the discussions that follow. It is this personal contact between members which will help to keep our Institution alive. It is only by such personal contact that we, as members, can keep ourselves *au fait* with what is taking place, and maintain that mental flexi-

bility so necessary if we are to successfully cope with new and ever more intricate problems.

Listening to, and taking part in, the discussions that follow our lectures is, in my opinion, a certain way of tapping new sources of thought. The problem under discussion may be one that does not touch us personally, but there is always sure to arise some little point that will throw a new light on some of our own problems, or a new view point from which to build up our experience. Each lecture, nay, each question asked in a discussion, is like a stone thrown into a pond. They cause ripples of thought that are ever spreading and it is from these ever widening circles of thought that information will spread until it embraces the whole of those engaged in production engineering.

Rationalisation of Industry.

Having given you some idea of the work that the Institution of Production Engineers is doing, may I briefly touch on a subject which many feel may affect the future welfare of production engineers themselves? For some time now we have been hearing a good deal about Rationalisation of Industry, and many speakers and writers have tried to visualise just what this means. No two authorities appear to agree as to just what this term does mean, and as a consequence many technical men are wondering how rationalisation will affect them. I recently saw an article in which it was stated that technical executives ought to closely examine this question of rationalisation from the point of view of how it would effect their status; and also—from another angle—that is, whether it will affect their chance of employment.

You will remember that at the beginning of my talk I spoke of the evolution of the production engineer. This evolution was the result of a rational movement towards specialisation in the engineering industry, and any new movements that may take place under what is known as rationalisation of industry will, I think, tend more in the direction of still further specialisation than in the direction of putting out of employment those executives now in engineering.

Let us examine this idea for a moment and see just what rationalisation of industry may mean so far as the production engineer is concerned. As I see it, rationalisation means applying to industrial management in its larger field, just those truths which production engineers have been preaching for a long time, namely, Standardisation; Concentration of Effort; Elimination of Waste, both human and material; and Improved Distribution. To achieve these ends, those in charge of industry will adopt the same means as we in the works have hitherto used in our efforts towards efficiency. We re-arrange our shops, re-group our machines, re-plan generally

our organisation, etc. In this new movement, Industrial Management will re-group industries.

In the past many of our re-arrangements in the shops have been futile and such I believe will also be the fate of many of the industrial concentrations that will be attempted. I believe, however, that the lines indicated by the present trend of Rationalisation are in the right direction, and that eventually trial and error will eliminate the unfit establishments. It is, of course, possible, some think inevitable, that these re-groupings will mean lack of employment in certain directions. Frankly, I do not think that this will operate in the case of technical men. Experience in the past shows that our movements have been such that we have needed more and more technical assistance. My view is, that Rationalisation of Industry, so far as engineering is concerned, will provide production engineers with greater opportunities than ever for putting into practice their slogan.

This being a new Section I may perhaps be excused for repeating that our slogan is—Increased Productivity with Lower Costs, coupled with Increased Earnings and less manual labour for the Working Force. But to live up to these opportunities which I suggest we shall get, we production engineers must do all we can to keep in touch with the latest developments in our line. We must make every effort to keep our minds flexible and receptive, and above all, we must learn to observe. In this connection may I, before I close, tell a story concerning Faraday.

During his life, Faraday carried out something like 18,000 experiments, and as you know, it is largely on the discoveries made during these experiments that the electrical industry of to-day is erected. Besides being a great man, Faraday was also an extremely modest one. In one of the diaries that he has left, written when he was about sixty years of age and at a time when he had already laid the foundation for our present electrical industry, he has written—" I must learn to observe." What a lesson for all of us—We must learn to observe ! Learn to see those things that are actually around us; learn to correlate those things that we see; learn also to apply them to the common good. If we do this, then we shall be not only better production engineers, but better citizens. In conclusion, Mr. President, I must once more say how much I appreciate the honour of being allowed to address you on this, your opening night.

Mr. J. A. Hannay, Chairman of the Council of the Institution, said that after hearing Mr. Groocock's address there was little he could add except to give his warmest support to their new Glasgow Section. The Institution was formed following the end of the Great War by men who hoped to be able to lay the foundations in this country of a new science of production engineering which would help the country to recover from the wastage of the war

years. After a somewhat difficult struggle in the early years of the existence of the Institution, membership started to grow. There was no question of competition with the older institutions. They deal almost entirely with the science of the particular branch of engineering which they represent, while we have to carry out and put into practical shape the plans and ideas of the designer. Most inventors would rather stay in the office experimenting than go into the workshop and manufacture. A corporate body of engineers had to be formed by the men who manufactured the product designed by the inventor. While the Britisher is second to none as a worker, this country still lacked a certain amount of organisation, and the institution they were helping to build up would give them greater scope for sound national development.

MR. E. GIBSON KNIGHT, speaking as a new member of the Glasgow Section, said that although he was a member of one of the older technical institutions he realised after reading some of the lectures and discussions of this Institution that it could be of immense practical value to those engaged in production. Personally, he had gained much useful information from the reports of the half-dozen lectures and discussions he had perused. He was not afraid that there would be any overlapping with other institutions. One had only to compare the syllabus of the production engineers with those of other institutions to see that there was no danger of that kind. He had great pleasure in proposing the following resolution, "That this meeting heartily welcomes the formation of the Glasgow Section of the Institution of Production Engineers and wishes it every success."

The resolution having been seconded by Mr. W. H. Denholm, the Chairman announced that questions would be welcome, and a number of points were raised.

MR. ANDREW NESS asked whether he, as an employer, could become associated with the Institution in spite of the fact that he was not a production engineer.

MR. HANNAY, in reply, said that any firm interested in the work of the Institution could become affiliated and nominate one or more of its members as Affiliates. Affiliates had all the rights of full membership except that of voting.

MR. PLATT asked whether, in addition to the lectures and discussions, the Institution set up Committees composed of experts on various subjects that required investigation.

MR. GROOCOCK said that the Institution had Special Committees on subjects such as Payment by Results, Education, etc. At the same time it was mostly individual contributions that were of value in the progress of science. In industry, he had no use for committees.

The resolution was put to the meeting and carried with enthusiasm, after which cordial votes of thanks to Messrs. Groocock, Hannay and the Chairman were adopted and the meeting concluded.

SEVENTH ANNUAL DINNER OF THE INSTITUTION.

THE seventh annual dinner of the Institution was held at the Holborn Restaurant, London, on Friday, October 24, 1930, Mr. Tom Thornycroft (President), in the chair.

After the toast of "His Majesty the King" had been honoured, SIR WALTER KENT proposed "The Institution." In his humble opinion, he said, the Institution of Production Engineers is one of almost supreme importance to industry in this country to-day. When many men with a common interest were gathered together there was a contagious enthusiasm which tended to stimulate their energies and increase their activities. In the case of an Institution such as the Institution of Production Engineers this could not fail to promote the interests of production in every way and at the same time it gave greater hope and pointed to the greater scope for the work in hand. The engineering industry consisted of so many parts and there were so many institutions concerned with it that it was difficult to map out a section which belonged to the work of the production engineer; the fact was that the work of the production engineer was spread over all branches of engineering. Engineering might be divided into two sections. There were those engineers who were concerned with railways, docks, large bridges and what might be termed the bigger sections of engineering work, all of which, however, required the services of the production engineer because the materials and parts required were manufactured by him. In the other section of engineering was the work concerned with the manufacture of articles of various kinds in vast numbers, and in either case we had to depend upon the genius and the efficiency of the production engineer for maintaining the prosperity of the country because by that efficiency alone could we meet competition in our own country, in the Dominions and abroad, and, therefore, in that way only could we effect that exchange of goods which will keep the finances of the country upon anything like terms of equality.

Having regard to the importance of the position and work of the production engineer, it had rather surprised him that the membership of the Institution was not larger, but it was satisfactory to know that membership was now growing at a rate of over two hundred a year. Out of the present membership, one hundred and eighty-five came from the Birmingham and Coventry district, and one hundred and forty from London. It seemed to him that London —and he presumed this included Greater London—had not provided as many members as it should have done, whilst there were many sections of the country which were not represented at all in the

membership. The Institution was endeavouring to improve the knowledge of the craft by the reading and discussion of papers and by the training of Graduates. The selection of a paper dealing with one subject and the reading and discussion of it at the various Sections throughout the country was an excellent idea and when the reports of the various meetings appeared in the Institution Journal they could not fail to be of the greatest possible value as bringing together the latest information on the particular subject. Another matter in which the Institution could do good work was in regard to visits to works of engineering and other interest and that introduced the great question of whether we in this country, in regard to this particular matter, should work on American lines or British lines. In America, any manufacturer would through open to his rivals all the processes in his works, the view being that by so doing everybody will benefit in the long run. Here, in England, there was a great tendency, when a process was developed which was more efficient than the method previously adopted, to keep it secret. It was only by the dissemination of information and knowledge that we could help each other and also the country. Personally, he was all out for helping each other and hoped the Institution would follow these lines. As to the training of Graduates, that needed no words from anybody to recommend it. The " Catch 'em young " principle came in here and the earlier lads were taught to appreciate the wonderful work that could be done by the production engineer, the better for them and the better for the country in the future. He personally regarded the production engineer and mass production as the parent of industrial engineering and in coupling the toast with the name of Mr. E. W. Hancock, the Chairman-elect of Council, Sir Walter wished continued prosperity and an ever-widening scope of activity to the Institution.

Mr. E. W. Hancock (Chairman-elect of Council), who responded to the Toast, said that during the past year the membership had shown a gratifying increase and it was a great satisfaction for the future to know that the Institution is now properly organised with a full time General Secretary, staff, offices, council room and library. That was a very different state of affairs from what was the position a few years ago and the Council was satisfied that the Institution is now going along on the right lines. Moreover, the Institution was financially sound, and there was every indication that progress would now be much quicker than it had been. Continuing, Mr. Hancock said that at past annual dinners the two questions had almost always been raised of why the Institution did not amalgamate with some other institution and what was the definition of a production engineer. In the first place, he asked how it was possible to amalgamate with another institution something that could not be defined. Whilst he did not propose to give a definition of a production engineer he was inclined to say that just as John Citizen

was the backbone of the country, so the production engineer was the backbone of industry. The production engineer was the John Citizen of industry, and as between the directors on the one hand and the workpeople on the other there were a large number who were eligible to become members of the Institution. During the past session the Institution held thirty-two meetings at the various sections but this year the number was to be forty and the fact that last year the average attendance was between one hundred and one hundred and twenty-five, sufficiently indicated the keenness of the members in the work of the Institution. Looking back at the progress made during the past ten years, Mr. Hancock said that whilst he did not agree with those who said we are not such good mechanics as we were he did believe that we are not much better than we were. At the same time the new element of planning had entered into engineering businesses. We had developed the habit of planning, pre-thinking, forecasting and knowing what was going to happen before it happened, and unless that new element was pushed to the fullest extent businesses could not be financially sound or successful. A look round the Olympia Exhibition was sufficient indication of what the John Citizens of industry had accomplished in two years. What was being done by the motor car industry was a wonderful example of the work done by members of the Institution and others eligible to be members. Incidentally, he suggested that if the proposal to have one large building to house all institutions in London came about, then the Institution of Production Engineers should be placed right in the centre of that building, because the work of its members was so inter-connected with every branch of industry. Whilst it had been said there were too many institutions he suggested there is still room for another institution, viz., the Institution of Sales Engineers, because no matter how good or cheap might be their production, all came to nought if they could not be sold. What was the sales force in this country doing with regard to pre-thinking, planning and forecasting the future? Whilst we had a super-abundance of the type of man who could persuade the local vicar to buy a motor car, what were we doing in what he called pioneer salesmanship not only at home but abroad? An instance of what he meant was the manner in which the American motor car manufacturers made it clear to the governing authorities of South America that they must improve their roads. The result of such efforts might not be manifest for four or five years but such pioneer salesmanship amply repaid itself in time. Therefore, he suggested there is a big opportunity for an Institution of Sales Engineers because sales engineering is so definitely allied to production. Another instance that came to his mind was aeroplanes, and aeroplane engines. What were we doing to develop overseas markets in this connection? Finally, Mr. Hancock suggested that

production engineers should receive far more encouragement from the boards of directors than they often were given and claimed that if the work of the Institution, by that means, was enlarged so the country would benefit because of the greater outlet that would be provided for the goods produced by the production engineer.

MR. W. G. GROOCOCK (President, Birmingham Section), proposing "Our Guests," and offering a hearty welcome to all the visitors, said the slogan of the Institution is increased productivity with lower costs coupled with higher earnings for our workpeople. He claimed that the Insitituion had already done remarkably good work in these directions and expressed the belief that if the work of the Institution had been more widely advertised during the early years of its life, the membership would be very much larger than it is at present. The Institution wanted more members, but it did not want members who would not take an interest in its work or attend its meetings. It was the personal contact by attendance at meetings and taking part in discussions that was required in order to improve the knowledge of production engineering and it was because the Institution was founded on the basis of widening the scope of the contact among those interested in production engineering that they were pleased to have so many guests at their dinner.

MR. J. D. SIDDELEY, responding to the Toast of "Our Guests," proposed by Mr. W. G. Groocock, said he spoke as a business man whose duty it was to translate into action the things that were possible from the financial and manufacturing point of view. There were other considerations in industry than mere production. Frankly, his own position would be an extremely easy one if he merely had to consider production. But the world was not a place for the man who merely wished to produce in mass. Too much had been heard of mass production. The world had become rather obsessed with it and he could not help feeling it was now sufferng as a consequence. The evils or misfortunes which the world was now suffering from were, he claimed, due to over-production and this over-production had come about through what Mr. Hancock had been glorifying. In other words, there had been too much high pressure salesmanship going on in the world. It had been too easy to sell because the customer had not been asked to pay for the goods he had taken. That, he contended, is cold fact and in no way an exaggeration. The world to-day, moreover, had begun to realise it and until the world had paid what it owes we should have to be content with a very quiet period. British engineering at its best was not so-called mass production but was to make the highest grade engineering production the world had ever known. After all there could only, in any country, be one or two organisations such as those of Ford, Morris and Austin, and for the rest he would prefer to speak of high class batch production, making

the batches as large as the demands call for. His own view was that better productivity and lower costs must inevitably mean less workpeople employed.—(No, no). He claimed that America has shown that there must be fewer people employed when production was increased and costs lowered, and that the present conditions in America proved it. It was true that there had been a great deal of high pressure salesmanship in America. They had made high pressure salesmanship a god out there and had overdone it and he felt convinced that the old-fashioned method of this country would prove to be the best in the end. Reference had been made to the aeroplane business and he could say something about that because he was a director of the largest aeroplane business in the United States. Last year that company lost £700,000, whilst another company, the Curtis-Wright Co., the largest producers of aircraft and aircraft engines in the world lost £1,100,000, and at the end of last year had 6,000 engines in stock which they could not find a market for. On the other hand, British producers of these goods made in smallish quantities and were able to sell in any part of the world that aeroplanes could be used. Moreover, British makers were able to get higher prices and were doing good business. In his opinion high pressure salesmanship, which had for its object the encouragement of people to buy what they could not pay for, was unwise.

MR. R. H. HUTCHINSON proposed the toast of "The President" and said it needed no words of his to indicate the feelings of the Institution towards Mr. Tom Thornycroft in face of the fact that the Council had unanimously and without the slightest hesitation elected him to serve for another year. Speaking with regard to the Institution, Mr. Hutchinson said he regretted that the time had come when, owing to increasing responsibilities, he personally would not be able to do as much for the Institution as he had done in previous years, but he was satisfied now that the Institution was on a sound footing. As to the membership, he could say in all seriousness that the membership could have been very much larger if the Council had cared for it to be so but they had preferred to go carefully in that matter and generally there was a very strict scrutiny now as to those who were admitted to membership. Everybody would admit that, having regard to the position to-day, that policy had paid well. Referring to what had been said by previous speakers, we had always been prone, to look upon production engineering in the light of a programme of output of motor cars per week. As a matter of fact, the manufacture of motor cars, as a special line, was now relatively insignificant in the work of the Institution. The Institution dealt with the underlying principles common to all production, from battleships to gramophones or, as he had said on a previous occasion, from motor cars to mangles. It did not make any difference; there were certain underlying principles

which applied to all production. He therefore begged and prayed the members to try and keep their minds on that line of thought rather than on the fetish of more production at a much cheaper cost only in terms of mass production. If they looked at the syllabus of papers for the coming sesson they would realise how the Council was giving effect to that, and also the change that had taken place in the outlook of the Institution since the early years. The Institution had made great strides during the term of office of the President. In the matter of education, the scheme for the examination of Graduates was complete and was officially recognised. The certificate of the Institution would be accepted as a definite standard of education for young fellows. Further, the Institution had recently been called in to consultation, quite voluntarily, by the City and Guilds of London Institute, to form a joint Committee for drawing up a syllabus for the training of fitters, turners and machinists. All this was an indication of the work the Institution was doing and he repeated the hope that the members would try and think along these lines.

THE PRESIDENT, who was given a most cordial reception on rising to acknowledge the toast, said he must apologise for not having given more time to the work of the Institution during his year of office. Last winter and spring, however, he had had to spend a great deal of the time abroad on business and therefore had been guilty of not giving anything like the time to the affairs of the Institution which he otherwise would have done. In the circumstances, therefore, he appreciated all the more the great honour done him in electing him for a further period of office. Continuing the President said he thoroughly agreed with what had been said on the question of mass production. The principles of production engineering applied just the same to one large bridge as they did to the manufacture of a million small screws. The aim must be to produce in a more efficient way than before, and if we kept that in mind we should avoid getting our minds warped. As to the Institution itself, he was proud of it and of the fact that it is financially sound and he was convinced that if they all put their hearts and souls into the work they would make the Institution one of the most important institutions in the country. All the theory in the world was of little use unless we turned out something that was competitive. This country for many years was the workshop of the world but now we had to fight very hard against all the countries of the world who wished to produce their own goods and the only way we could export sufficient goods to keep the country going was by making our production more efficient than that of any other country. Finally, the President congratulated the General Secretary on the work he was doing for the Institution.

RULES AND SYLLABUS OF THE EXAMINATION FOR GRADUATE MEMBERSHIP OF THE INSTITUTION.

(As revised, April, 1931)

Objects of the Institution.

Among the objects for which the Institution is established are :—

" (a) To promote the science and practice and raise the status of production engineering; and to initiate and carry through any scheme or to organise any movement likely to be useful to the members of the Institution and to the community at large in relation thereto.

(b) To hold meetings of the Institution for reading and discussing communications bearing upon the matters enumerated in paragraph (a), or the application thereof, or upon subjects relating thereto.

(c) To enable engineers to correspond, and to facilitate the interchange of ideas respecting improvements in the various branches of the practice of production engineering, and the publication and communication of information on such subjects to the members.

(d) To establish scholarships, organise lectures, hold examinations, to grant premiums and prizes for papers and essays, and by any other similar means to enlarge the knowledge and improve the practice of production engineering."

Qualifications for Graduate Membership.

As defined in the Articles of Association the qualifications for Graduate Membership are :—

" Graduates shall be persons, not under twenty-one years of age, who can show evidence that they are receiving practical training in production engineering, and who have passed an examination prescribed from time to time by the Council, or who otherwise satisfy the Council that there are special circumstances which, in the opinion of the Council, entitle them to admission.

Graduates may not continue as such if they cease to follow the professional calling of production engineering, nor in any case beyond the age of thirty; they may, however, between the ages of twenty-five and thirty be transferred, on application, at the discretion of the Council, to the class of Associate Members.

Candidates for admission as Graduates who have passed the aforementioned examination but who have not yet attained the age of twenty-one, may attend the meetings and receive the publications of the Institution without charge, but shall not be entitled to vote at meetings or be entered in the Register of Mem-

bers; but on attaining the age of twenty-one they may apply to be admitted as Graduates, and upon being so admitted shall have their names entered on the Register and become Members of the Institution.

No person shall be elected a Graduate after the completion of his twenty-fifth year."

The Annual Subscription for each Graduate is £1 up to twenty-five years of age, and £1 10s. between twenty-five and thirty. On admission to the Institution Graduates may be required to pay an entrance fee, the amount of which shall be determined by the Council from time to time. At present, and until further notice, no entrance fee is charged.

Award of Free Graduate Membership.

The Council of the Institution will award Free Graduate Membership up to 25 years of age each year to those candidates who attain the five highest places in the Examination for Graduate Membership.

Examination Conditions.

Examinations will be held each year on the Saturday following Easter Sunday, in London, Glasgow, Birmingham, Manchester, and Bristol, and also at any approved University, Technical Institution or Works School elsewhere as may be required. Where less than five candidates enter at any centre for the examination, a local fee, additional to the ordinary examination fee of 10/-, may be charged.

Candidates are required to fill up the prescribed Form of Application for Graduate Membership (which can be obtained on request from the Head Office of the Institution, or from the Hon. Secretary of any Section of the Institution) and to send the Form, together with the examination fee of 10/- to the General Secretary, not later than 31st December. Where permission to sit for the examination is not given, the examination fee will be returned.

The Examination will be divided into five sections. Work on the first section—an Essay—will be performed at home and must be submitted not later than 28th February, whilst the remaining sections will be covered at an examination centre.

The examination will be of six hours duration, with an interval of one-half-an-hour, from 2.30 to 8.30 p.m., but candidates must present themselves not later than 2.15 p.m. at the place of examination.

Candidates must provide themselves with drawing instruments, scales, and set squares at examinations during which they may be required. Four-figure Logarithmic Tables and squared paper will be provided by the Institution. No other books or instruments may be carried into the examination room. Slide Rule calculations will be accepted throughout.

The list of successful candidates will be printed and posted to each candidate between one and two months after the examination. No other examination certificate will be issued.

SYLLABUS.

The following Syllabus for each of the five sections of the examination is given to indicate the lines of study recommended to candidates, and is not intended to limit their interests but to direct it in desirable lines.

Copies of the Examination Papers for 1931 are printed elsewhere in this pamphlet. A general knowledge of the subjects is expected and the questions should not be beyond the capabilities of those who have taken an inquiring interest in their chosen profession, although their experience is of necessity limited.

The five Papers of the Institution Examination are intended to test the candidate in those special branches which are of peculiar importance in Production Engineering. In evaluating the candidate's work, the examiners will be guided rather by the practical knowledge and interest shown than by an academic reproduction of text-book information.

The Council of the Institution feel that although one of the major problems of Production Engineering is that of the human factor involved in the relations between Capital, Management, and Labour, too little attention has been given to this important subject in the Curriculæ of Technical Schools. In the Papers on Works Organisation and Workshop Practice and Processes, therefore, some questions will be framed not only to reveal the candidates' attitude towards their fellow-workmen, but to discover their mental attitude towards Industry in general and Production Engineering in particular.

First Essay.

Two Essays are required, one to be done at home, the other to be done during the examination. Candidates whose Application Form has been accepted will be required to submit an Essay of from 1,000 to 1,500 words on a Production Subject, within four weeks of the despatch of such notification. A list of Subjects will be supplied. Works of reference may be consulted by candidates, *the titles of such works should be stated.* The Essay must be accompanied by a Declaration that, subject to the consultation of works of reference, it is the unaided work of the candidate.

Works Organisation.

Time 1½ hours.

Forms of Organisation and their uses.
Scientific Management and its application.
Departmental Organisation.
The Storing, Handling, and Movement of raw, part-finished, and completed materials.
Considerations affecting the construction of a works in respect of locality, power, heating, lighting, water, and transport services.

Workshop Practice and Processes.

Time 2 hours.

Workshop Drawings. Correctly dimensioned free-hand sketches.
Modification of designs of simple articles to facilitate production.
Limit Systems.
Machine Tools and their Uses.
The design of cutting edges.
Feeds and Speeds.
The planning and sequence of operations.
The influence of quantities upon methods.
Applications of Jigs and Tools.

Interval of half-an-hour.

Second Essay. Time ½ hour.

There will be no interval between this and the next part of the examination, but the Essays will be taken up at the end of the time allowed for them.

Industrial Economics.

Time 1½ hours.

Elementary Economics and its applications, e.g., Wealth, Land, Capital, Turnover of Capital, Profit Margins, etc.
The influence on industry of Home Office requirements.
Employers' Federation and Trade Union Regulations.
Incentive Systems including: Payment by Results, Profit-Sharing, Co-Partnership, etc.
Methods of (a) Estimating Costs.
(b) Building up Costs.
(c) Distribution of Overhead Charges.
Control of Purchases.
Relation of Sales Department to Production.

Forms of Application.

Intending candidates should apply to the General Secretary to

the Institution, or to the Hon. Secretary to any Section of the Institution, for the necessary Forms of Application for Graduate Membership.

Exemption from Graduate Membership Examination.

Candidates who have passed Section C of the Associate Membership Examination of the Institution of Mechanical Engineers, or any approved examination of equal standard, will be exempt from this examination.

EXAMINATION PAPERS, 1931.*

First Essay.

An Essay of from 1,000 to 1,500 words on *one* of the following subjects :—

(a) Improvements in modern machine tools : their advantages.

(b) How the Production Engineer cheapened the manufacture of motor cycles.

(c) Interchangeable manufacture.

(d) Factors, other than machine tools, affecting production costs.

(e) The value of technical literature to the Production Engineer.

Works Organisation and Practice.

Time allowed, 2½ hours. Maximum Marks, 150.

Candidates are required to answer Questions 1 *and* 2 *in Part I of this Paper and Question* 8 *in Part II. In addition, they are expected to answer two other questions, which may be selected from either Part I or Part II.*

PART I.

1. Trace out the routine followed by a production order covering the manufacture of 500 brackets, in accordance with the drawing mentioned in Question 8. The routine should cover the receipt of the production order, and be followed right through to the despatch of the finished article. Explain briefly what happens at each stage of progress. (36).

2. Outline a stores routine suitable for a large works and the system of records to deal with purchasing, inspection, control of material and manufactured parts, and stocktaking. (36).

*Since the 1931 Examination the Syllabus has been extended and re-arranged.

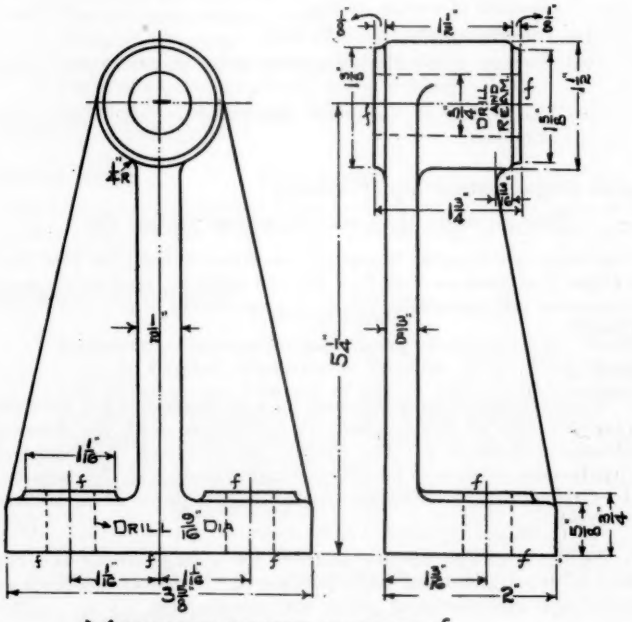
3. Discuss the factors underlying the selection of a site for a works. State the type of works. (21).

4. Describe briefly any two systems in each case of (*a*) heating and (*b*) ventilating in factories. (21).

5. Show in tabular form the three main divisions of a works organisation controlled by the general manager, and detail the scope of each division. (21).

6. With reference to diagrammatic sketches describe any two appliances for the mechanical handling of goods in a factory. (21).

7. Plot a 10 per cent. depreciation graph covering a period of ten years on a basis of £100 original cost. From your graph determine the present value and the amount in the depreciation fund for a machine purchased six years ago at £439. (21).



PART II.

8. How would you produce 1,000 brackets to the attached drawing? Give a sketch of any one non-standard tool you would use. (36).

9. Schedule two self-checking combinations of slip gauges for 2.4972 inches, and explain how you would test them for relative wear. (21).

10. With reference to a diagram name the different angles of a cutting tool. Discuss these angles in a twist drill. How and why does the question of point thinning arise? (21).

11. One hundred and twenty $\frac{1}{2}$-inch Whitworth bolts, shank 4-inches long, screwed 1-inch, have to be machined from hexagonal mild steel bar. The feeds are respectively—turning 90, facing 100, and parting-off 120—all at a speed of 200 r.p.m. The screwing speed is 60 r.p.m. Draw up a production estimate sheet, and make suitable allowances for contingency, feeding bar forward, changing tool to tool, and gauging. Determine the machining time for the batch. (21).

12. A certain article can be machined in 40 minutes on a plain lathe, or in 9 minutes on a turret lathe, or in 3 minutes on an automatic. The total operating costs per hour are respectively: plain lathe 1/9, turret lathe 2/6, and automatic 3/-. The cost of setting-up the turret lathe is 8/- and for the automatic 37/-. Determine the economical manufacturing quantities respectively for the turret lathe and for the automatic. (21).

ESSAY AND ELEMENTARY ECONOMICS.

PART I.

Essay. Time allowed—half hour. (50).

Select *one* only of the following four subjects:

(*a*) The Stock Exchange. (*b*) Flow Sequences. (*c*) The Phenomena of a Trade and Credit Cycle. (*d*) Limit Systems.

PART II.

Elementary Economics. Time allowed—1$\frac{1}{2}$ hours. Maximum Marks: 100.

Candidates should attempt to answer FIVE *questions. Each answer will have a maximum value of* 20 *marks.*

1. State Adam Smith's principles of taxation, and show how far they are applied to individuals, industry, and commodities in this country. Distinguish between a prohibitive duty and a revenue producing duty.

2. In diagrammatic form show the main divisions of Economics and the scope of treatment of subject matter in each division.

3. Describe the functions of the two forms of capital in industry. Enumerate the various kinds of shares and explain their relative privileges.

4. A fair and reasonable estimated time for the completion of a job is 8½ hours. Fix (i) the piecework price and (ii) the basis times for the following methods of payment by results: (*a*) Taylor differential piecework, (*b*) Halsey-Weir bonus, and (*c*) Rowan premium bonus system. Assume a time rate of wages of 1s. 3d. per hour and that the 100 per cent. efficient man will be able to increase his hourly rate by 50 per cent.

5. The following data refer to a factory manufacturing and selling cars at £100 each. "N" represents monthly output in 1,000's of cars and "TC" represents total costs (production and sales) per car.

N	1	2	3	5	7	9	11	13	15	16	17	18
T.C. £...	200	135	110	94	86	81	79	78	80	83	88	102

Plot "N" and "TC" and comment on the shape of this graph. Determine respectively the output at which manufacture (*a*) becomes profitable, (*b*) ceases to be profitable, and (*c*) gives maximum profit. What is the maximum profit and the percentage profit per car at the output giving maximum profit?

6. Explain the various methods of allocating production and sales oncosts.

7. Enumerate and discuss the various forms of combinations of capital and labour.

8. Explain the various uses of gold, silver, copper, and paper in our monetary system. What are the causes of the slump in the price of silver?

9. Give a short account of an example in industrial legislation, and comment upon the commercial and social aspects of the case.

10. Write brief explanatory notes on *any three* of the following: (*a*) The iron (or brazen) law, (*b*) division of labour, (*c*) elasticity of demand, (*d*) rate of exchange, and (*e*) localisation of industries.

11. Account for the variations in the value and rent of land in different localities.

12. Outline a plan of campaign for the selling organisation of a large firm conducting home and foreign business.